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Abstract

CONTRIBUTION TO THE UNDERSTANDING OF THE NATURAL EVOLUTION OF PETROLEUM: RADIATION EFFECTS ON CRUDE OILS

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In several regions of the world asphalt deposits associated with sedimentary radioactive rocks are known. It is believed that such accumulations, in some cases of considerable commercial importance, may have some connection with radiation effects on less complex molecules, such as liquid hydrocarbons, present in sedimentary basins.

Other agents (catalysis by minerals in contact rocks, oxidation, temperature, pressure) may have played a synergistic role with radiations in determining the chemical modification of hydrocarbons. Also the presence of bitumen with no commercial value - and yet significant when it comes to the exploration of oil fields - may be due to the radiation effects on simpler hydrocarbons migrating from their source rocks towards the reservoirs.

This paper reports the results of irradiation experiments on some Italian crude oils in the presence of different sedimentary rocks and water, in environmental conditions similar to those known for sedimentary basins. The total radiation doses employed are comparable to those which may be absorbed in geologic times by organic material associated with more or less radioactive shales.

Considerable radiation effects on the structure, distribution of molecular weights and viscosity of irradiated crudes were found.

Along with the formation of complex condensed molecules, light liquid and gaseous products are formed. Worthy of note the fact that irradiation in the presence of certain natural catalysts, particularly when water-wet, leads to the formation of much less hydrogen and unsaturated molecules than are obtained

when crude oils are irradiated without catalysts. This might explain why despite the primary role that radiation is believed to have played in the natural evolution of petroleum, at least in some instances neither hydrogen nor unsaturated products are very abundant in sedimentary basins.

In connection with these experiments it was found that irradiation of crude oil and of their distillation fractions in the presence of suitable catalysts brings about interesting chemical modifications which improve the quality of the oil in relation with its subsequent refining and chemical utilization.